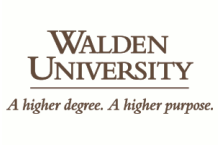

2019

Influence of the Reflex Math Fact Fluency Program on Math Scores

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This is to certify that the doctoral study by

Tammy D. Cress

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Andrea Wilson, Committee Chairperson, Education Faculty
Dr. Charles Bindig, Committee Member, Education Faculty
Dr. Dianne Lefly, University Reviewer, Education Faculty

The Office of the Provost

Walden University
2019

Abstract

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by

Tammy D. Cress

MA, Winona State University, 2003

BS, Southeastern University, 1985

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

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November 2019

Abstract

Researchers have shown a correlation between students' math fact fluency and their achievement in higher-level math. The problem investigated by this study was that 59% of students in intermediate elementary grades at the local school were not proficient in math. Guided by Miller's information processing theory, the purpose of this quantitative, causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on 2nd graders' math achievement scores (as a whole group and by gender) after 1 school year of program use. Archival data was purposefully sampled for 98 2nd grade students (n = 50 boys; n = 48 girls) who were continuously enrolled for the entire 2018-19 school year and completed both the Fall 2018 and Spring 2019 Star Math Assessments prior to and following exposure to the Reflex Math Fact Fluency Program. Results of a repeated measures t test showed students' scores after using the program for 1 school year were significantly higher than the same students' scores before the program. Additionally, a mixed-design ANOVA revealed a significant interaction effect such that girls' scores before the program were higher than the boys' scores but were lower than the boys' scores after the program. Findings suggest that the Reflex Math Fact Fluency Program can be a valuable tool for elementary level students, especially boys, who are learning basic math skills. Implications for positive social change include providing the school's stakeholders with a policy recommendation that may influence students' access to additional instructional opportunities in math which could, in turn, lead to improved student achievement in math over time.

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Dedication

I would like to take this time to dedicate this project to my family, friends, and co-workers who never stopped believing in me. I would especially like to thank my husband, Greg Cress, who patiently waited in the background taking care of business as I worked. His love and faithfulness are beyond words. I would also like to thank my mother, Velma Miller, who has been my role model, champion, and cheerleader throughout my entire life. Thank you to Aaron Cress, Eric Cress, and Katelyn Cress for your constant love and support as I worked as well as your confidence in me. I would like to thank, Gregory Deal, my supervisor and friend, for helping to restore my confidence after a heart-wrenching situation that had a major impact on me. His prayer, guidance, and many kind words provided healing. Finally, I would like to thank Dr. Andrea Wilson for her patience, perseverance, and wisdom. God has been my strength throughout my life and his loving grace, mercy, and compassion have motivated me and guided my steps as I completed this project.

Acknowledgments

I would like to thank my chairperson, Dr. Andrea Wilson. Dr. Wilson's support, encouragement, and steadfast belief in me have been an inspiration. I would also like to thank my committee members, Dr. Charles Bindig and Dr. Dianne Lefly, who helped with revising and editing. Additionally, I would like to thank the school district for allowing me to conduct my research and working with me along the way.

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Section 1: The Problem

The Local Problem

Compared to 35 other countries in 2015, the United States ranked 31st in math performance on the Program for International Student Assessment (PISA; Organization for Economic Cooperation and Development [OCED], 2016). The PISA is an assessment given internationally by the OECD (2016) in 35 countries to measure the academic success of 15-year-olds in math, science, and reading. Schleicher and Davidson (2012) discovered that the United States devotes more money per student than most countries with below-average results. Students in the United States were found to have problems with math literacy, which includes basic math facts (Berrett & Carter, 2018). Basic math facts are the grammar of math, and students need to have basic math literacy in place before moving on to more difficult math skills. Mastering math facts in elementary school are predictive of future math proficiency (Nelson, Parker, & Zaslofsky, 2016). According to Rave and Golightly (2014), United States students are lagging behind those of other countries. In 2015, the math scores for the United States were down compared to 2013 (Harris, 2015).

National and state education stakeholders work continuously to increase student achievement in math toward reducing disparities for significant subgroups of students. One of those subgroups is gender. At the study site elementary school, the State's Department of Education stated that 37% of girls scored at the proficiency level in math, where 52% of boys were proficient. If the scores keep going downward for girls, the gap will continue to become more significant as time passes. The 2015 PISA results showed

that in the United States, boys scored higher in math than girls (OCED, 2016). The mean score for the boys was 475 and 464 for girls (OCED, 2016). The OCED results showed that boys scored higher than girls in each of the 35 countries represented except in Korea, China, and Finland. The gap is closing but still exists.

The state calculates school grades for all schools in the state on an A-F rating scale. The performance of math is a significant factor in the ranking of schools (Burnette, 2018). Knowledge of basic math facts is a significant problem for students in upper elementary grades who are not learning basic math facts with automaticity to assist them in higher-level math skills. The problem at the study site elementary school was that, at the time of the study, 59% of students in upper elementary grades were not proficient in math. The result was that the school fell from a B ranking in 2016–2017 to a C ranking in 2017–2018. For the 2018–2019 school year, the school set a goal for 65% for math proficiency for students in Grades 3–5 on the state's standardized test. According to the district's website, third graders who took the 2018 state standardized test ranked 66th out of 87 elementary schools in the district with 40% scoring proficiency. Focusing on math facts in second grade will allow third grade teachers to focus on higher-level mathematical concepts instead of math fact fluency. The study site elementary school implemented a math fact program called the Reflex Math Fact Fluency Program in five second grade classrooms to improve student mastery of math facts in students entering the tested grades. Students used the program during math center time for 30 minutes daily to help them achieve fluency of basic math facts.

In this study, I used a causal-comparative design to investigate the problem of 59% of students in upper elementary grades not being proficient in math at the study site elementary school. In the first section of this study, I introduce the local problem and the rationale, define operational terms, provide the significance of the study, identify the research questions and corresponding hypotheses, review the extant literature related to the topic, describe the implications, and summarize the study. Information is also provided regarding current levels of math performance for students taking the State's Standard Assessment (SSA) as well as gender-related student performance data. Section 1 also includes an introduction to the theoretical framework comprised of Miller's information processing theory.

Rationale

Federal regulations indicate that the achievement gap in math and other subjects must close in all subgroups, including the disparity between genders (Thurlow, Wu, Lazarus, & Ysseldyke, 2016). An achievement gap in math has been shown to exist between the study site elementary school and other elementary schools in the same region. The study site elementary school ranked 66th out of 87 elementary schools in the same district. The problem at the study site elementary school is that 59% of students in upper elementary grades are not proficient in math.

The importance of simple math fact fluency is evident. According to Crawford, Higgins, Huscroft-D'Angelo, and Hall (2016), math fact fluency correlates with student achievement in math, including performance on state standardized tests. Along with the automaticity of facts, math fact fluency is acknowledged as requiring enhanced

consideration in classroom math instruction (Flawn, 2008). Math fact fluency refers to the speedy, prompt recollection of basic, single-digit math facts (Rave & Golightly, 2014). Benefits of math fact fluency include less math-related stress and pressure on cognitive function when working on more challenging tasks (Musti-Rao & Plati, 2015). Math fact fluency is central to higher-order mathematical calculations.

Along with many factors related to a lack of math success, educators must also look at the students and their achievement with basic math facts. In their study on the importance of math fact fluency for intermediate students, Nelson et al. (2016) discovered that struggling learners improved on state tests after acquiring math fact fluency. Whitney, Hirn, and Lingo (2015) revealed that students with behavioral problems who became fluent in math facts improved their math and critical thinking abilities. The National Mathematics Advisory Panel observed that math fact fluency is vital for later success in math (Flawn, 2008). Learning basic facts in elementary grades is vital to the achievement of more advanced mathematical concepts.

According to Wang and Degol (2016), the gender gap has recently been on the decline; however, females continue to take a diminished role in math-related disciplines, such as science, engineering, math, and technology (STEM). Schwery, Hulac, and Schweinle (2016) suggested that the stereotype that boys do well in math and girls do well in reading is supported by research. While examining the gender gap in 19 African countries, Dickerson, McIntosh, and Valente (2015) discovered a considerable difference in math scores in favor of boys. In the study site elementary school, boys outscored girls in math by 15% on the SSA.

Second grade students take the SSA for the first time in third grade. Third grade students face a great deal of stress and anxiety due to the high-stakes consequences of the SSA reading. If students in third grade score a Level 1 on the reading test, they are retained in third grade (Every Student Succeeds Act, 2019). Students are pushed and trained for the entire year in both math and reading to get them ready. Baker and Cuevas (2018) found that success with math fact automaticity is critical for students in mathematics. Students who do not know the basic math facts are also pushed and trained to learn them as well as reading due to their importance on the SSA. Third grade is an incredibly taxing and challenging year for students and learning all their basic math facts before entering third grade will take some of that pressure off them. According to one second grade teacher at the study site, math fact fluency poses a challenge for most of the students in her class. This second grade teacher stated that in a classroom of 18 second graders, students were using their fingers to compute basic math facts and are falling further behind due to a lack of automaticity in their basic math facts. Another second grade teacher claimed that she tried flashcards and timed tests without success. Both teachers indicated that simple math fact fluency is a significant factor in attaining math proficiency.

According to Allsopp, Lovin, and Van Ingen (2017), the success of students in mathematics is contingent on several components: approaching mathematics with a positive attitude, developing a conceptual understanding of topics, increasing the ability to problem solve using critical thinking, and improving reasoning skills. For 3 of the 4 components to fall into place, knowing basic math facts is significant. Math fact fluency

may be instrumental in narrowing the mathematical achievement gap between males and females as well as the disparity between the study site elementary school and other elementary schools in the county, which was the focus of this study. In this causal-comparative study, I examined the Reflex Math Fact Program for its influence in solving the problem at the study site elementary school.

Definition of Terms

I used the following definitions in this study, and they appear here as a resource for clarifying educational terminology and describing the problem:

Achievement gap: A disparity in academic performance between two groups (Harris, 2015).

The State's Standards Assessment : The SDOE created a battery of reading, writing, and math tests in 2015 to measure student performance on the State Standards. The State Standards Assessment replaced the state's Comprehensive Achievement Test.

The State's Standards: A set of content standards taught throughout the state, giving educators directions on what students must know and do at each grade level. The standards are based on the Common Core Standards and were implemented on February 18, 2014 (Razzouk, 2014).

Math fact fluency: The ability for students to recall basic mathematical problems with speed and accuracy and without hesitation (Cozad & Riccomini, 2016).

School mobility: Moving or changing schools during the school year for reasons other than promotion (Friedman-Krauss & Raver, 2015).

Significance of the Study

A gap in practice for the study site elementary school occurred after taking the state's standardized assessment in the Spring of 2018, only 59% of students in third through fifth grades were proficient in math. Second grade students take the SSA for the first time in third grade. Sending students to third grade with a solid foundation in basic math facts sets them up for success on the SSA in math. Forbringer and Fuchs (2014) stated that math fact fluency is the capability to rapidly and effortlessly find the response to a problem without hesitation because the response is memorized or a strategy to find the answer was used. Students who are deficient in math fact fluency will have problems with overall math performance (Nelson et al., 2016). The Reflex Math Fact Fluency Program is used in the study site elementary school in all second grade classrooms. The findings of this study contributed to filling the gap in practice by completing a causal-comparative analysis of the Reflex Math Fact Fluency Program to determine if the program was effective in helping students in second grade carry math fact fluency with them to third grade, the first tested grade. The Reflex Math Fact Fluency Program claims that it helps students with math fact fluency, continuously differentiates instruction for students, makes math fun and motivating as students play games with math facts to achieve success, and provides reports for teachers and administrators (Cholmsky, 2014).

Research Questions and Hypotheses

Using data from the Star Math Assessment in the Fall 2018 and Spring 2019, the purpose of this quantitative, causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at

one elementary school. I also explored the difference between scores for genders in that same group of second graders. The following research questions and corresponding hypotheses guided the data collection process for the study:

Research Question 1: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for second grade students in math after using the Reflex Math Fact Fluency Program for one school year?

$H_0$1: There is no difference in assessment scores for second grade students on the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Math Star Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

$H_1$1: There is a significant difference in assessment scores for second grade students on the Spring 2019 Star Math Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

Research Question 2: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for males in second grade who have participated in the Reflex Math Fact Fluency Program for 1 year as compared to female, second grade students who have participated in the Reflex Math Fact Fluency Program for 1 year?

$H_0$2: There is no difference in Spring 2019 Math Star scores of male and female second grade students who participated in the Math Fact Fluency Program for 1 year.

$H_1$2: There is a significant difference in Spring 2019 Star Math scores of male and female second grade students who participated in the Reflex Math Fact Fluency Program for 1 year.

Review of the Literature

In this literature review, I concentrated on factors that contributed to the research on basic math facts and achievement; computer programs, such as the Reflex Math Fact Program, and their influence on math achievement; the comparison between genders in math achievement; how students learn in general; as well as extant literature on the theoretical/conceptual framework. Numerous scholarly and professional literature was reviewed, including recent doctoral dissertations, peer-reviewed journals, and subject-specific information from multiple electronic databases.

I used current, peer-reviewed articles to research findings on the implications of math fact fluency and gender on math success. The current, peer-reviewed articles in the literature that I located were published from 2014 to 2019. Literature published before 2014 was also used to document theories and traditional methods of math instruction after the use of current literature had reached saturation. Older works were also used to record changes in the examination connected to the significance of basic math facts and their role in student achievement. To locate extant literature, I used the following keyword terms and phrases: *math facts, elementary math instruction, barriers to math instruction, gender and math scores,* and *factors affecting math success*. Boolean phrases, such as *math facts AND student achievement, math instruction AND gender,* and *basic math facts AND technology,* were also searched.

I analyzed the extant literature on math fact fluency, gender gap, the Reflex Math Fact Fluency Program, strategies used by teachers for math fact fluency, and other computer software programs available. Peer-reviewed articles, the Internet, and books relating to the conceptual framework were also used as additional sources. Additionally, searches of dissertation databases were performed to find similar studies that addressed the need for math fact fluency in elementary students. I found supporting information on math fact fluency, Reflex Math Fact Fluency Program, and the gender gap in mathematics in the ERIC, Center for Research Library, EBSCO, and Google Scholar databases.

Current Public Data

Each spring, the students in the state take the state's standardized assessment in third through 10th grades. The scores are reported to the school staff, students, parents, and the public through the SDOE website. The SDOE releases a press statement as to the time and date of release. The SSA scores are released beginning in May and continue through June, and the school grades come out in July each year.

Theoretical Framework

With numerous types of technology accessible, immediate access to friends and family, work colleagues, and websites from around the world is a click away. In this technology-driven world, almost every phase of life includes making a decision about how to select, sort, store, and use information. It is not unexpected that at least one development theory would use a technology comparison to concentrate on how children process information (Miller, 2016).

The theoretical framework for this quantitative study was based on Miller's information processing theory. Miller's information processing model focuses on how students acquire, process, and remember information (Slate & Charlesworth, 1998). According to Miller (2016), information processing investigators look at the flow of information in the cognitive system. The movement of data starts with some input into the human processing center, such as a math fact to be solved, and concludes with an output that can be warehoused in long-term retention (Miller, 2016). Input and output operations occur in real-time (Miller, 2016). When students are using a computer-assisted program, such as the Reflex Math Fact Program to practice math facts, they are taking the information in through the software application and providing output by quickly recalling answers from memory.

Mental processes are like a computer program that accepts information, performs operations, then stores it. Both humans and computers take data and transform input into an output. Perceiving can be likened to input, thinking equated to a computer program, storing likened to the number of gigabytes available, the delete key associated with forgetting, a computer search likened to recall, and decision-making compared to output. The circuitry of a computer is not unlike the structure and operation of the human brain (Miller, 2016).

The information processing theory became popular with developmental theorists because it presented a set of specific cognitive processes to guide children's thinking (Arnold, 2012). The theory focuses less on the steps in solving a problem and more on the mental processes it takes to solve the problem (Miller, 2016). Information processing

scholars study the flow of information students obtain to process and remember information (Arnold, 2012).

In the center of cognitive psychology is the theory of information processing. Cognitive psychology looks at a person as a mainframe of facts, figures, and other information exactly as a computer takes data and tracks a program for output (Arnold, 2012). A person can recognize the information processing theory through its specific characteristics. Miller (2016) explained by stating:

> Viewing humans as information processing systems, conceptualizing, development as self-modification, conducting task analysis, and using information processing methodology. All these address two main characteristics of human thought: Our thinking is limited in both speed of processing, the amount we can attend to at any one time, and our thinking is flexible, to get around these limitations and adapt cognitively to both internal changes such as changed plans and external changes such as a new task (p. 323).

The characteristics of the information processing theory compare thought mechanisms to a computer processor in that it obtains, manages, and produces output. The goal of the information processing theory is to identify the procedures that motivate intellectual functioning (Miller, 2016).

Math Fact Fluency

Results from the PISA showed that compared to 35 other countries in 2015, the United States ranked 31st in math performance (OCED, 2016). Approximately 52% of fourth graders struggle with learning mathematics in the United States (National Center

for Education Statistics, 2017). One general characteristic of students struggling with higher-level math includes the inability to recall basic math facts with automaticity. According to Whitney et al. (2015), students who grapple with the acquisition of math fact fluency require concrete-representational abstract teaching methods, including hands-on materials to represent math problems, pictorial representations, and reinforcement opportunities. Using a computer-based math fact program provides all three of these teaching methods for students learning basic math facts.

Math fact fluency is defined as the ability to quickly and correctly answer a group of basic math facts in addition, subtraction, multiplication, and division (Musti-Rao, Lynch, & Plati, 2015). Automaticity in math facts is the foundation for a constant mathematical expansion of abilities (Pol, 2016). Schoolchildren struggling with math fact fluency often fail in more complex mathematical concepts (Musti-Rao, Lynch, & Plati, 2015) . Math fact automaticity offers an opportunity for students to succeed in higher-level mathematics.

Most states approved new standards in 2013 to address national concerns about student achievement in math (Anderson & Harrison, 2012). The Common Core State Standards for Mathematical Practice set arduous grade expectations for all students; even children with disabilities were included (Common Core State Standards Initiative, n.d). The Common Core State Standards for Mathematical Practice requires students to have a profound grasp and practical confidence of academics and expects that students are proficient in all four basic mathematical operations (i.e., addition, subtraction, multiplication, and division) by the end of third grade to succeed in higher-order math

(Common Core State Standards Initiative, n.d). Math fact fluency is assumed by teachers to be in place for third grade students.

Flawn (2008) found that fluency of basic math facts is a vital skill for student achievement in math. Forbringer and Fuchs (2014) defined fluency as the skill of a student to quickly and fluently respond because it is committed to memory or because the student has acquired an approach to answer without hesitation. Regrettably, numerous children never attained essential math fact fluency, which leads to difficulties in higher-level math. Teachers have an assortment of approaches available to teach basic fluency with math facts. Simple approaches, such as flashcards, timed activities, and counting, are often critiqued due to their inability to provide engagement and for inspiring approaches such as finger counting (Hawkins, Collins, Hernan, & Flowers, 2017).

Math fact fluency is essential for every student because automaticity helps students succeed in general math. The information processing theory aligns with the opinion that math fact fluency is crucial to the accomplishment of success in higher-level math (Miller, 2016). If students cannot recall basic math facts automatically, they are likely to suffer from extreme mental stress and recurring mathematical errors (Baker & Cuevas, 2018).

Gender Gap

A multitude of researchers over the past 40 years have studied the possible gender gap in academic achievement (Yarbrough, Cannon, Bergman, Kidder-Ashley, & McCane-Bowling, 2016). Gender achievement gaps are typically projected by comparing male and female scores on standardized tests. Studies have shown that females outscore

males in reading and writing, but when it comes to math, males outperform females (Reardon, Kalogrides, Fahle, Podolsky, & Zárate, 2018). According to Cimpian, Lubienski, Timmer, Makowski, and Miller (2016), gender differences appear to be consistent despite the healthy study habits many girls exhibit.

Nollenberger, Rodríguez-Planas, and Sevilla (2016) investigated the role of culture regarding the gender gap in math. Their study focused on the cultural beliefs and the roles of women in society and their role in reducing the gender gap in mathematics. Nollenberger et al. found that two thirds of the factors relating to cultural beliefs affected the gender gap.

STEM careers are male dominated (Wang & Degol, 2016). Women are underrepresented in mathematical and technical occupations. Charles, Harr, Cech, and Hendley (2014) found that stereotypical male and female personality traits were consistent around the world. Females are viewed as being able to foster and build personal relationships, while males are viewed as being more logical and physically stronger than females (Charles et al., 2014). Robinson-Cimpian, Lubienski, Ganley, and Copur-Gencturk (2014) observed that elementary teachers tend to rate boys higher than girls in math. Ridgeway and Correll (2004) found that in the United States, people tend to lean toward the social positions that are matched to their disposition and gender identity. To change gender stereotypes, educators, parents, and mentors should keep away from enforcing gender labels and look at the individual’s strengths and weaknesses regardless of gender.

By the time females move to second grade, they often begin to exhibit a negative attitude regarding math (Tichenor, Welsh, Corcoran, Piechura, & Heins, 2016). They may believe the stereotypes and begin to mistrust their abilities even believing they are not capable of being good at math. During math class, girls may experience embarrassment and attempt to stay in the background, and their anxiety may even lead to issues with problem-solving in math. The gender bias might lead to minimal success in math and a feeling of inferiority in math class (Parsons, 2016).

Sax, Kanny, Riggers-Piehl, Whang, and Paulson (2015) defined math self-concept as a person's perceived confidence in the domain of math. Math self-concept is considered a central predictor of math success (Sax et al., 2015). There are many factors that lead to low math self-concept, such as experiences in primary and secondary classrooms that are then reinforced by teachers, family, and peers (Sax et al., 2015). Gender differences may also contribute to the stereotype that math is considered a field for males and reading language arts are a female field.

The literature I reviewed related to gender differences in math has illustrated the existence of a gap between males and females in math. According to Wang and Degol (2016), the gender gap is beginning to narrow but is still prevalent. Women's roles are diminished in fields connected to STEM. The importance of developing math fact fluency is essential for all students, especially girls, because the concept of automaticity is a predictor of future math performance (Baker & Cuevas, 2018).

The State's Standardized Achievement Test

The state standards were adopted in 2014 in English language arts (ELA) and math to prepare students to be college and career ready by accentuating critical thinking skills. The SSA is the assessment used to measure success on the state's standards. According to the SDOE, the SSA test provides a more reliable assessment of the standards than the previous tests. Students generate graphs and interact with the assessment content by writing to explain. Questions on the SSA assess higher-order thinking in keeping with the state's high academic expectations.

The SSA assesses ELA and math. In third grade (ELA), students are assessed on reading and listening skills. In fourth and fifth grade the ELA assesses writing, reading, and listening skills. The math assessment focuses on grade-level State Standards in math and requires students to create graphs, interact with test items, and respond by placing some answers into a grid. The SDOE Portal is the most significant source of information for parents, teachers, and students for the SSA. The portal contains practice tests, parent information, and supports for schools.

The SSA is given to students each spring. Students receive scale scores, achievement levels, percentile ranks, and raw scores. Scores are released in June of each year. Scale scores were created by the SDOE to establish cut scores for achievement levels. The scale score ranges have five different levels that correspond to the achievement levels. According to the SDOE, achievement levels describe a student's level of achievement on the assessment using a scale of 1 through 5. One is the lowest and 5 is the highest on the scale. The percentile rank shows how a student performed in

comparison to all students in the state who took the assessment. Raw scores are the number of questions answered correctly on the assessment.

The State's Law section 1008.25(5) of the state's statutes declares that third grade students scoring a level 1 on the reading SSA will not be promoted to fourth grade (Every Child Succeeds Act, 2019). The law does provide for exemptions known as Good Cause Promotions. Four exemptions are allowed by law. The first exemption is intended for limited English proficient students who have been in the English speakers of other languages program for less than two years. Students with disabilities whose Individualized Education Plan indicates that participating in the SSA is not a proper assessment for them is the second exclusion. Demonstrating satisfactory achievement on a state-approved standardized testing alternative approved by the board of education is the third exemption. The fourth exemption is for students to show proficiency in a portfolio that is maintained throughout the third grade year.

A reading difficulty must be addressed by third grade to allow students to move onto more challenging course work in fourth grade and beyond. As students move through the grades, the texts become more complex and the reading more difficult. Reading passages become longer, and the textbooks are more challenging to comprehend. Students begin to use books, websites, and other written materials to complete research in the content areas. Students who cannot understand what they read and become frustrated with school are faced with years of difficulty in school. The state law is meant to head off reading problems in third grade (Every Student Succeeds Act., 2019).

Star Math Assessment

The Star Math Assessment is being used to at one elementary school as a progress monitoring tool. For this study, it was used to compare student outcomes before and after using the Reflex Math Fact Fluency program. The Star Math Assessment was created by Renaissance Learning to serve as a tool for assessing, progress monitoring, instructional planning, predicting ability, and showing mastery of math standards (Renaissance Learning, 2017). The program was purchased by the school district to provide support for students in grades kindergarten through fifth grade. According to a technical report created by Renaissance Learning (2017), the Star Math Assessment is highly recommended by the National Center on Intensive Intervention and the National Center on Response to Intervention.

The Reflex Math Fact Fluency Program

The Reflex Math Fact Fluency Program provides three research-proven approaches with technology to assist students in mastering math facts through the computer-based program. The three methods Reflex uses are progress monitoring for individualization, a variety of reports to monitor progress, and it provides students access anywhere they have a computer and the Internet (Cholmsky, 2014). Additionally, the Reflex Math Fact Fluency program offers a powerful solution for students in developing math fact fluency (Cholmsky, 2014).

The Reflex Math Fact Fluency Program is a game-based method used to move toward math fact fluency. Cholmsky (2014) maintains that the program is a comprehensive solution for fluency development that covers the complete process of

math fact fluency, continuously differentiates instruction, is fun and motivational, and provides educators with insightful reports to monitor progress. Reflex requires students to use the program for at least 30 minutes each day to allow the program to work efficiently.

The approach Reflex uses is based on the cover, copy, and compare procedure. Stocker and Kubina (2016) define the cover, copy, and compare (CCC) strategy as a self-managed math instructional strategy that allows students to develop math fact fluency through intensified chances to answer, recurrent chances to respond and instant feedback. The strategy was initially designed for spelling but has been adapted as a math fact fluency intervention. CCC is still being used in classrooms at the study site elementary school.

In addition to CCC, the Reflex Math Fact Program also uses fact families to cover all four operations. Typically, student's fluency with subtraction and division lags addition and multiplication affecting their comfort with fractions (Cholmsky, 2014). Reflex Math Fact Program addressed subtraction with addition and division with multiplication.

Math Fact Fluency Strategies

Several strategies claim success with math fact fluency. One method is a mnemonic approach. According to Baker and Cuevas (2018), a mnemonic strategy involves an image or a word to acquaint with a number. The picture creates a visual image for the student crafting a better chance of recall. Nelson, Burns, Kanive, and Ysseldyke (2013) researched the comparison of the mnemonic strategy and technology to

increase math fact fluency. They found that both groups improved overall, but the group that was given technology outperformed the group given the mnemonic strategy.

The (CCC) method is a low cost, practical strategy for teachers to use. It is successful because it uses fundamental features of effective instruction: modeling, ample practice, and feedback (Konrad & Joseph, 2014). CCC teaches students to view the response and study it (model), cover the right answer, and write it down from memory (practice), expose the right answer, and check to make sure the answer is accurate (feedback). If the response is accurate, the student attempts the next problem. If it is incorrect, the process is completed (Konrad & Joseph, 2014).

There are several computer-assisted options available for the practice of math facts with computers, laptops, tablets, and smartphones. Computer-assisted instruction may present additional engaging activities to encourage the development of math fact fluency (Hawkins et al., 2017). The first critical component of computer-assisted options is one that gives students ample opportunities to respond. Repeated practice builds math fact fluency. Next, the program should offer immediate feedback. Once the student responds, the computer program should quickly give feedback. If no feedback is provided, students will keep practicing with an incorrect answer (Hawkins et al., 2017). Pacing is another significant feature to look for in computer-assisted options. The program needs to be fast enough to keep students involved but relaxed enough to reach students at their instructional level. Engagement is essential to have in a computer-assisted option (Rich, Duhon, & Reynolds, 2016). Engagement and motivation can significantly enhance math fact fluency. Progress reports that are provided to teachers is

also another component to look for in computer-assisted instruction. Teachers can use the reports to differentiate and plan instruction.

The taped program intervention contains a self-monitored audio recording process that allows students to listen to audio recordings of basic math facts followed by short gaps and then the answers are given for the math facts (McCallum & Schmitt, 2011). Students are given sheets to use to follow along and then are prompted to outdo the recording by writing the response to the math fact before the recording responds. If the student does not solve the math fact in the time given or fails to respond, they write the answer to the problem when it is given on the recording. Taped recording allows for numerous opportunities to respond, reinforcement, and feedback (McCallum & Schmitt, 2011). Poncy, Jaspers, Hansmann, Bui, and Matthew (2015) found that taped recordings have been found to improve accuracy and fluency.

The use of flashcards with direct instruction to assist students with basic math fact fluency has been a common strategy used in classrooms; however, its use is random and not evaluated. When using this procedure, flashcards are shown to students quickly. The card is positioned at the back of the stack of cards if the student's answer is accurate. When a math fact is missed, the teacher says the math fact and its answer with the student repeating it. The fact is given over again, and if the student answers the fact correctly three times, it is placed at the back of the stack of cards. After moving through the entire stack, the student goes on to the next activity (Skarr et al., 2014).

Finger counting plays an integral role in math fact fluency at some stages of development. Since our hands are a visual representation of 10, fingers can help with the

understanding of math. Using fingers to count helps reduce memory load and relieves some anxiety as an instant solution to a problem. Finger counting can be used as a remedial source for solving math facts. The research on finger counting is limited (Calder Stegemann & Grünke, 2014).

Number talks is a math fact fluency strategy developed by Parker and Richardson. Number talks is a short strategy that can be used in the classroom and at home. When using number talks, a teacher asks students to calculate a number sentence such as 12 x 3 mentally. Students then share all the different strategies they used to find the answer. The number talks strategy allows students to develop mental math and gain conceptual knowledge at the same time (Boaler, 2015).

Math Fact Fluency and the State Standards

Math Fact Fluency Standards are prevalent in kindergarten through fifth grade. According to State Standards students are required to recognize the answer to two one-digit numbers at the end of their third grade. Fact fluency takes many years and begins in kindergarten in the state (see Table 1). Fact fluency is a critical skill for learners as they start to rely on them for higher-level math. Math fact recall with automaticity reduces the cognitive load for schoolchildren and allows them to focus on solving more complex and higher-level math problems (Berrett & Carter, 2018).

Table 1

Table of the State Standards Fact Fluency

Grades				Third through Fifth Grades		
Concepts that lead to fluency: • Addition • Subtraction • Place Value				Concepts that lead to fluency: • Multiplication • Division • Fractions • Problem Solving		
The state's standards for Math Fact Fluency	**Kindergarten** *MA.K.OA.1.5* Fluently add and subtract within 5	**First** *1.OA.3.6* Fluently add and subtract within 10	**Second** *0A.2* Add and subtract within 20 *NBT.5* Add and subtract within 100	**Third** *OA.7* Multiply and divide within 100 *NBT.2* Add and subtract within 100	**Fourth** *NBT.4* Add and subtract within 1,000,000	**Fifth** *NBT.5* Multi-digit multiplication

Note. Adapted from *Addition and subtraction fact strategies*: by the Wichita Public Schools, 2014

Additional Math Fact Online Programs

Reflex Math Fact Program is just one software program available for classroom use. There is an abundant number of programs used to improve math fact fluency that range in price from free to an annual cost of $3,000 for an entire school. Rocket Math, Operation Math Squad, and Sushi Monster are three of the programs that are accessible for classroom teachers to use.

Rocket Math charges $200 to $300 per year for a school providing 50 teachers with the program. Dr. Crawford is the founder of Rocket Math. According to Crawford

(n.d.), the Rocket Math program will work for all students. Rave and Golightly (2014) examined the effect of Rocket Math on math fact fluency. The study found that Rocket Math was a suitable strategy to use for math fact fluency. During the 9-week study, 93% of the 44 student participants improved in math fact proficiency. Rocket Math did improve math fact fluency rates in the students; however, it did have some shortcomings. The program is designed to be student-driven to allow for more engagement and interaction from the student. As they ran the intervention themselves, some students had a misunderstanding of how the program operated, and some were found cheating. Rave and Golightly found that Rocket Math is a positive support for the classroom for math fact fluency.

Operation Math is an app available for purchase for $2.99 per student. According to Spinlight Studio (2019), the app was created in 2014 for students struggling with math facts. The app uses over 100 missions for students to use to address three skill levels (SpinLight, 2019). The one significant shortcoming is that Operation Math does not provide feedback for students.

Sushi Monster is a free online math fact fluency practice game. The Scholastic company developed the Sushi Monster program for students (Wilkey, n.d.). Students practice addition and multiplication math facts while playing the game. Problems increase in difficulty in response to correct answers (Wilkey, n.d.). Sushi Monsters does not offer instant feedback and is not available for multiple children. The app also does not provide practice in subtraction and division.

Direct Instruction in Teaching Math Facts

According to Cox (2015), direct instruction (DI) is a teacher-led model for teaching that was developed by Engelmann and Becker in the 1960s. Winarno, Muthu, and Ling (2017) found that direct instruction is simple and easily implemented in the classroom. The guiding principle for those who use direct instruction is that every child can learn if they are taught with fidelity and that all teachers can succeed if they are given all the tools they need (Engelmann, 2015). DI uses instructional approaches that are structured, planned, and lead by teachers in a lecture or demonstration that is directed at students. Organization of DI in the classroom focuses on (a) grouping students based on their abilities, (b) instructional time, and (c) continued assessment.

DI includes components such as modeling and scaffolded practice (López, Torrance, Rijlaarsdam, & Fidalgo, 2017). Modeling refers to the presentation of ideas and concepts by the teacher with the whole class or a group of students (Wette, 2014). Wette (2014) found that modeling is a useful strategy and contributes to teaching effectiveness. Without modeling, direct instruction does not yield as much success (López et al., 2017). Scaffolding is an instructional technique that is designed to move students gradually toward an understanding of a concept. When using scaffolding, a teacher provides successive levels of support for the student that helps them learn the concept. The supportive strategies are removed when they are no longer needed (Brower et al., 2017).

According to Davis (2018), DI would include a teacher working directly with a small group, and later that same teacher imparting knowledge to the class. Davis identified a flaw in the use of DI in that it is teacher lead and not student lead. He goes on

to say that teachers and administrators should not accept DI if the only reason it is being used is that it is evidence-based. Other criticisms of DI are that it relies too heavily on basic skills and that it is too rigorous (Smith, 2018). DI is highly structured and an intensive program that is geared to meet the needs of high-risk children and to accelerate their learning (Smith, 2018).

Math facts taught using DI can help students struggling. Leach (2016) used DI for special needs students having problems recalling math facts. Using modeling, multiple practice opportunities, and immediate feedback, Leach provided instruction in math facts daily to achieve mastery. The use of an A-B-C procedure was used. A was an antecedent that caused a student response (a flashcard). B was for a behavioral response from the student (a correct response). C was the consequence, offering praise for a correct answer, or more time if needed with a cue. After 5 weeks of the intervention, the students were able to correctly identify 80/80 math facts presented (Leach, 2016).

Math Anxiety

Many students face anxiety when it comes to math. Being math confident is vital to success and performance in math (Flanagan & Einarson, 2017). According to Ramirez, Shaw, and Maloney (2018), anxiety in math occurs when there is panic, nervousness, and anxiety when they are doing any math-related activity. A student who is anxious about math may not only be worried about math class, but he or she may also have a physiological response. Physiological responses include neural reactions, and heart rate increases. Ramirez et al., suggested using questionnaires to find those who may have math anxiety.

Wang, Shakeshaft, Schofield, and Malanchini (2018) investigated the connection with math anxiety and math motivation. They defined math anxiety as fear and tension related to math. Math motivation is the extent to which a person sees math as valuable and relevant to them. Wang et al. argued that math anxiety and math motivation are related yet different. They found that math anxiety in students does not result in the avoidance of math tasks; however, math motivation does result in avoidance. Students with math anxiety were more engaged in their work.

Schaeffer, Rozek, Berkowitz, Levine, and Beilock (2018) found that the math anxiety of fathers and mothers was linked to how much knowledge their children acquire in kindergarten through third grade. Children in lower grades whose parent had math anxiety learned less than parents who were not anxious. The study found that the group whose parents had higher anxiety levels were behind the lower anxiety parent group by 5 months in math (Schaeffer et al., 2018). Some of the high anxiety parents were given a math app to use with their children to help alleviate the adverse reaction. Schaeffer et al. discovered that the math app did decrease anxiety in children through first grade.

According to Cvencek, Kapur, and Meltzoff, (2015), math self-concept and anxiety are related to math success. Math anxiety can be prompted by various activities presented in class. Sorvo et al. (2017) found that numeric processing, performing math tasks in front of the class, and making errors are activities that were found to create math anxiety. A strain on working memory and avoidance of activities that involve math are two of the effects of anxiety in math. Sorvo et al. investigated anxiety in math and the relationship it has to basic math skills for students in grades two through five. Math

anxiety occurred in students as soon as second grade, about one third of the students reported anxiety about being incapable of performing basic math facts, and one-fifth reported anxiety about answering their teacher's math questions (Sorvo et al., 2017).

As addressed in my examination of current research, mastering the basic math facts in elementary school is significant to success in math. Implementing a computerized math fact program such as the Reflex Math Fact Fluency Program may ultimately improve performance in math in elementary school and beyond. Learning basic math facts is beneficial to all students in math. I would promote an in-depth look at the increases in student achievement when students learn math facts with automaticity. This type of study would help to determine the influence of implementing a computer-based math fact program to learn basic math facts on students in second grade.

Implications

Using the Reflex Math Fact Fluency Program is a possible intervention to use to aid in math fact fluency in the elementary grades. The Reflex Math Fact Fluency Program is costly for districts. This research has implications for one school district in deciding to purchase the Reflex Math Fact Fluency Program or to use the funds toward another intervention.

At one elementary school, there were five second grade classes with 106 students divided among the classes. The students took the Star Math Assessment in the Fall 2018 and Spring 2019. The students used the Reflex Math Fact Fluency Program during their math center time and before and after school. After taking the Spring 2019 Star Math

Assessment, the scores were used to determine whether the Reflex Math Fact Fluency Program influenced student achievement in math.

Math fact fluency is critical to student achievement in mathematics. Emphasizing fluency in math facts will encourage the understanding of the grammar of math and assess where the district currently stands on student math fact fluency. This doctoral study may provide district administrators a way to assist struggling math students and give insight on needed professional development offerings for elementary teachers on building fluency in math. For students struggling with math, the time has come to make changes to what has always been done by providing students with a tool that will help them succeed in mathematics.

Summary

The purpose of this quantitative causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at one elementary school. The Fall 2018 Star Math Assessment and the Spring 2019 Star Math Assessment was used to determine the influence of the Reflex Math Fact Fluency Program on math achievement for second grade students and for males as compared to females after 1 year of participation in the program. Chapter 2 provides the methodology and research design and approach for the study. In this quantitative analysis, I investigated and studied the problem and gave recommendations as to whether the use of the Reflex Math Fact Fluency Program as a possible solution should continue in the future.

Section 2: The Methodology

Research Design and Approach

Quasi-experimental, causal-comparative research is designed to determine influences for an existing condition (Creswell, 2012). According to Lodico, Spaulding, and Voegtle, (2010), quasi-experimental, causal-comparative research is organized so that variables are controlled. In this study, I used a causal-comparative research design to attempt to determine if one variable, The Reflex Math Fact Fluency Program, influenced a change in the other variable, the Star Math Spring 2019 scores. I conducted this quantitative, quasi-experimental, causal-comparative study to provide information to administrators, teachers, and the school district that could foster a data-driven, decision-making process regarding the continuation of the Reflex Math Fact Fluency Program.

I chose a quasi-experimental, causal-comparative research study design because students are already in second grade classrooms with teachers who have their established instructional practices, and it was not feasible to randomly design a study for students to participate in the Reflex Math Fact Fluency Program (see Lodico et al., 2010). The study was designed to determine if the Reflex Math Fact Fluency Program affected student achievement in math for second grade students and males as compared to females after 1 year of participation in the program. The State Benchmark MA.2.OA.2.2 for second graders in math is to fluently add and subtract within 20. By the end of second grade, students should know all the basic math facts in addition and subtraction. In this causal-comparative study, I collected pre- and postscores for each student and compared the means for each group.

Setting and Sample

The setting was an elementary school in a Title I school district. According to the SDOE, the school is 32% White, 36% Hispanic, and 25% African American. The study site elementary school has approximately 700 students.

In purposeful sampling, researchers intentionally choose individuals to learn and understand a phenomenon (Creswell, 2012). I used purposeful sampling in this study, selecting the participants based on their grade level and the school they attended. Purposeful sampling does not require a large sample; the goal is to select a sample that will provide the best information to answer the research questions (Lodico et al., 2010). The participants in this study were chosen using purposeful sampling because it was consistent with the parameters for the study.

The population included all the second grade classes at the study site elementary school. The school has five second grade classrooms with 20 to 21 students in each classroom. The number fluctuates as the school experiences a great deal of mobility. Using the five groups of students, the total starting sample began with 106 participants. After excluding those who did not take both the Fall 2018 and the Spring 2019 Star Math Test, the final sample was 98 students.

I conducted a G*Power analysis to ensure that there was an appropriate number of participants for the *t* test to generate enough data points. To compute the sample size, a post hoc power analysis was conducted with a two-tailed *t* test. The results indicated that the 98 participants that were used in the study would be enough with a medium effect size convention of 0.76 and a power of 0.95.

All students enrolled in second grade at the study site elementary school were eligible for the study. Students who were continually enrolled throughout the entire school year and who were in attendance for the Fall 2018 and Spring 2019 Star Assessments were involved in the study. Participants were required to be enrolled in the school from Fall 2018 until Spring 2019 to be included in the study.

Instrumentation and Materials

The data retrieved for the study came from the Star Math Assessments that were given in the Fall 2018 and Spring 2019. All elementary schools in the school district were required to administer the Star Math Assessment three times per year: in the fall, the winter, and the spring. For this study, I only used the fall and spring scores to provide a pre- and posttest at the beginning and end of the school year, showing scores before implementation of the Reflex Math Fact Fluency Program and after. The Star Math test is a computer-based test, and those students who are provided testing accommodations on an Individualized Education Plan were afforded the adaptations as they took the test.

Star Math provides a variety of reports for educators. According to Renaissance Learning (2019), teacher reports of grade equivalency scores, normal curve equivalency, percentile rank, and scale scores can be generated. I used the scale scores for this study. The scale score ranges from 0 to 1,400 and is the fundamental piece for all the scores provided. Comparing students across time and grades is most useful for educators (Renaissance Learning, 2019).

The instrument used in the study was developed by Renaissance Learning (2019), a company that creates assessments and reports for reading and math. I requested the data

points from the school district. The data I received from the school district were de-identified. The students' gender was also requested with the data points. Concepts measured by the Renaissance Learning instrument were Fall 2018 and Spring 2019 scale scores.

The data for the study were collected by using the Star Math summary report. The summary report that Star Math provided showed the scale scores for the students participating in the study (Renaissance Learning, 2019). Included in the report were the student's name, age, date of the test, teacher name, and the student's grade level. None of the identifying information was collected for this study. Students who had not taken both tests were not included in the study.

According to Creswell (2012), reliability means that the scores being used are stable and consistent. Star Math uses two ways to check the reliability of the scores it provides: reliability coefficient and conditional standard errors (Renaissance Learning, 2015). Reliability coefficient refers to an overall precision of the test scores being provided (Creswell, 2012). Conditional standard errors refer to a summary statistic that gives the average amount of measurement precision in a specific testing group (Creswell, 2012). The reliability coefficient applies to the entire test where the conditional standard errors refer to an individual's result (Renaissance Learning, 2015). After multiple reliability tests, the Star Math was found to be reliable.

In addition to reliability, the researcher must make sure the scores being used in the study are valid (Creswell, 2012). A test has validity when it measures what it claims to measure. Renaissance Learning (2015) has determined the validity of the Star Math

test using two formats incorporating relationships with the rating teachers have of their students' math abilities: correlation to scores produced on an extensive collection of tests and state accountability tests. According to Creswell (2012), construct validity means the validity of assumptions about the variables in the study. Star Math seeks to establish validity by using data and other external information related to the test itself.

Data Collection and Analysis

In the study site school district, second graders used the Reflex Math Fact Fluency Program for the 2018–2019 school year. I compared the scores from the Star Math Assessment given in the Fall 2018 and the Spring 2019. The scores of male students and female students were also compared to find if there were differences in scores between the genders.

Research Question 1: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for second grade students in math after using the Reflex Math Fact Fluency Program for 1 school year?

$H_0$1: There is no difference in assessment scores for second grade students on the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Math Star Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

$H_1$1: There is a significant difference in assessment scores for second grade students on the Spring 2019 Star Math Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

Research Question 2: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for males in second grade who have participated in the Reflex Math Fact Fluency Program for 1 year as compared to female second grade students who have participated in the Reflex Math Fact Fluency Program for 1 year?

$H_0$2: There is no difference in Spring 2019 Math Star scores of male and female second grade students who participated in the Math Fact Fluency Program for 1 year.

$H_1$2: There is a significant difference in Spring 2019 Math Star scores of male and female second grade students who participated in the Reflex Math Fact Fluency Program for 1 year.

The study site district collected the data using the Star Math Summary report, which contains the scale score for each student. I compared the scores between the Fall of 2018 and the Spring of 2019. The archival data of 98 second grade students were used in the study. After collecting the data, a spreadsheet was used to record the scale score.

Because the same group of students participated in each Star Math Test, I used a repeated measures design to determine if there was a significant change in the independent variable, Fall 2018 and Spring 2019 scores for Research Question 1. For Research Question 2, a mixed-design ANOVA was used due to the two independent variables of time and gender. The time between administering the Reflex Math Fact Fluency Program (pre- and post-) was the repeated measure, and gender was an independent group four. The mixed-design ANOVA determined if the program has

affected the scores (pre- and post-) and if there is a difference in comparing gender. It also determined an interaction between the two variables.

Assumptions, Limitations, and Scope and Delimitations

The study was based on the following assumptions. I assumed all Star Math scores were reported honestly, and the test was a true representation of students' abilities. Another assumption was that all teachers administered the Star Math assessment with fidelity, making sure all test procedures were followed. The teachers were trained by Renaissance Learning using a webinar; however, when teachers administer a computer test, the computer is really in control. Finally, I assumed that all teachers administering the Star Math test were certified by the state in teaching second grade. The importance of these assumptions indicated that the participants were held to a high standard as they took the test.

The possible limitations in this study involved mobility of students and technology issues. Before the data were collected, I was concerned about the mobility of students between schools in the school district limiting the data that were used in the study. However, I found that only eight students' archival data were excluded from the study due to mobility. The district is known for mobility between schools. Another limitation was that of equipment. The school had issues with the computers that caused them to close the computer labs. The second grade teachers also had issues with the computers as well as Internet outages in their classrooms.

Variables in the study included gender, time, and the Star Math scale scores. In this study, I examined the second grade math scores and determined if the Reflex Math

Fact Fluency Program raised student achievement for second graders. I also looked at students' gender to compare the scores of both males and females.

Protection of Participants' Rights

To protect the confidentiality of the students, the data were de-identified in this study. I requested the data from the district after receiving permission from the Walden University Institutional Review Board (IRB). The Walden University IRB approval number was 05-10-19-0520942 and was valid through Walden University as long as I remained a student; however, the district validity date was May 30, 2020. All the data were stored on a password protected laptop. I was the only person viewing the data, and they were not shared with anyone.

Data Analysis Results

Creswell (2012) described the steps used in the analysis of data. The first step is to prepare the data for analysis. The second step begins the data analysis, and the third step is to report the findings using tables and figures. The data analysis procedures used in the analysis were aligned with Miller's information processing theory. According to Miller's theory, the brain is often compared to a computer. Data were first taken in (input) and then encoded, making meaning of the data. The process of data analysis is like saving and storing information in the brain until it is needed, much like a computer (Miller, 2016).

The purpose of this quantitative causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math

achievement scores at one elementary school. There were two key questions included in the study:

Research Question 1: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for second grade students in math after using the Reflex Math Fact Fluency Program for one school year?

$H_0$1: There is no difference in assessment scores for second grade students on the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Math Star Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

$H_1$1: There is a significant difference in assessment scores for second grade students on the Spring 2019 Star Math Assessment after 1 academic year of participation in the Reflex Math Fact Fluency Program.

Research Question 2: What is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for males in second grade who have participated in the Reflex Math Fact Fluency Program for 1 year as compared to female, second grade students who have participated in the Reflex Math Fact Fluency Program for 1 year?

$H_0$2: There is no difference in Spring 2019 Star Math scores of male and female second grade students who participated in the Math Fact Fluency Program for 1 year.

$H_1$2: There is a significant difference in Spring 2019 Star Math scores of male and female second grade students who participated in the Reflex Math Fact Fluency Program for 1 year.

The data for this program analysis came from the Renaissance Star Math Assessment. The Fall 2018 and Spring 2019 math scale scores were used for all second graders at an elementary school. After receiving approval to conduct research, access to the data was granted by the school district and imported into the Statistical Package for Social Sciences (SPSS). The Fall 2018 (pretest) and Spring 2019 (posttest) scale scores from Star math were de-identified to maintain confidentiality. The Reflex Math Fact Fluency Program was implemented in each second grade classroom throughout the 2018-19 school year. All data were stored on a password protected laptop.

Approval was received by the school district to conduct the research. Scale scores for the Star Fall of 2018 and the Star Spring of 2019 and the gender of each student were received from the district, and data analysis began. The data were then imported into the SPSS program. After inputting the data, SPSS provided descriptive statistics for the Star Fall 2018 pretest and the Star Spring 2019 posttest from the repeated measures data analysis. A mixed-design ANOVA was also used due to the two independent variables of time and gender in research question two. SPSS also provided a descriptive analysis for the mixed-design ANOVA.

Normal Distribution of Data

According to Lodico et al. (2010), a normal curve is a common distribution of data showing how it is spread out by the score. The Shapiro-Wilk was the most

appropriate test to use because it is generally used for a paired *t* test and ANOVA. Hanusz and TarasiŃska (2014) concluded that the Shapiro-Wilk Test was the best test for checking normality. Guner, Frankford, and Johnson (2009) documented and examined the Shapiro-Wilk test, comparing it to similar criteria and found it to be a formidable analysis for checking normal distribution. The Shapiro-Wilk was used to test the normality distribution of the data collected.

The data collected using the Shapiro-Wilk Test showed a normal curve. As shown in Table 2, the significance value was .299 for the pretest and the posttest was .880. The significance values were $p > .05$ so it can be concluded that the two tests were normally distributed.

Table 2

Tests of Normality – Shapiro-Wilk for Pre- and Posttest Data

Test	Statistic	*df*	*p*
Fall 2018	.984	98	.299
Spring 2019	.933	98	.880

The data in the sample were normally distributed, so the data analysis continued using a repeated measures *t* test and a mixed-design ANOVA. The two research questions were addressed with these two tests. The following sections address the outcome for the repeated measures t test and the mixed-design ANOVA.

Results

To address Research Question 1, what is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for

second grade students in math after using the Reflex Math Fact Fluency Program for 1 school year, the descriptive statistics were calculated to find the general tendencies in the data such as mean, mode, median (Creswell, 2012). The total original sample for Research Question 1 was 106 participants. Eight students were removed from the data set due to a transfer out of the school, putting the final number at 98 participants who met the criteria for the study. Those eight students were not present for both the Fall 2018 and Spring 2019 Star Math Assessments. In the Fall of 2018, the minimum scale score was 198, and the maximum scale score was 334. As table 3 shows, the minimum scale score for the group in Spring 2019 was 334, and the maximum was 704. The data showed an increase in scores from the Fall of 2018 to the Spring of 2019. Table 3 shows there was an increase of 370 scale points between the Fall of 2018 (334) to the Spring of 2019 (704). The data also showed that only one of the 98 students decreased in scale scores from Fall 2018 to Spring 2019. The whole group of students scored higher on the posttest by 307 scale score points.

A repeated measure *t* test was used to find if there was a considerable change in the Fall 2019 Star Math Assessment and the Spring 2019 Star Math Assessment. The results demonstrated that the difference was statistically significant *(t* = -20.865, *df* = 97), *p* = .000). It was predicted that there would be a significant difference in assessment scores for second grade students on the Spring 2019 Star Math Assessment after one academic year of participation in the Reflex Math Fact Fluency Program. The results showed that the students performed higher on the posttest. Therefore, I rejected the null hypothesis.

Table 3

Results of Repeated Measure

	N	*Minimum*	*Maximum*	*Mean*	*SD*
Fall 2018	98	198	589	379.81	77.489
Spring 2019	98	334	704	489.17	76.755

To address Research Question 2, what is the difference in the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment scores for males in second grade who have participated in the Reflex Math Fact Fluency Program for one year as compared to female second grade students who have participated in the Reflex Math Fact Fluency Program for 1 year, a mixed design ANOVA was used with the independent variables being time and gender. To fully address Question 2, analysis to examine the effects of time and gender as well as any interaction between the two variables were conducted. A mixed design ANOVA was utilized to further discover whether gender had any effect on students' scores on the Star Math Assessment. This included the variable of time (Fall 2018 Star Math Assessment and Spring 2019 Star Math Assessment) and the variable of gender. The results of the mixed design ANOVA showed statistically different results.

First as noted in Table 4 the main effect of time (Fall 2018 and Spring 2019 Star Math Assessment) was significant ($F(1) = 436.081$, $p = .000$). Students scored higher following a year's participation in the Reflex Math Fact Fluency Program. The analysis measured the difference between gender on the Fall 2018 Star Math Assessment scores as compared to the Spring 2019 Star Math Assessment. In the Fall of 2018, the females

scored higher than the males by 8.67 scale score points. However, by Spring 2019, the males' mean score, 491.31, was 4.46 scale score points higher than the females mean score, 486.85. Table 4 demonstrates that the main effect for gender was also significant ($F(1) = 1.432$, $p = .234$). There was a significant interaction *(*$F(1) = 3472.822$, $p = .000$) affect between the male and female groups. The girls scored higher than the boys in the Fall of 2018, but the boys scored higher than the girls in the Spring of 2019. There was a crossover of scores. Therefore, I rejected the null hypothesis based on the above findings.

Table 4

Results of Mixed-Design ANOVA

Effect	*f*	*df*	*p*-value
Time	436.081	1	.000
Gender	1.432	1	.234
Interaction effect	3472.822	1	.000

Summary

The findings revealed that the Reflex Math Fact Fluency did make an impact on scores for students who took the test in the Fall of 2018 and the Spring of 2019. The scores showed a difference in the mean between the two tests of 109.36. The Reflex Math Fact Fluency Program appears to have made a difference in test scores for the second graders at one elementary school. With the outcome of the study, students increased their Spring 2019 Star Math Assessment score by 370 scale points. The findings also showed a difference in male and female scores. Overall, students made significant progress in their Star Math Assessment scale scores after the use of the Reflex Math Fact Fluency Program.

Section 3: The Project

Introduction

Section 3 includes an examination of the position paper that was the resulting product of this project study and in which I recommended policy (see Appendix). A position paper was the best choice for moving forward with the results of this study because it is based on facts and validates the position with scholarly references (Bardach & Patashnik, 2019). In this study, I sought to examine the Reflex Math Fact Fluency Program's influence on student achievement in math for second graders in the study site elementary school. I focused on the second graders' Star Math Assessment scores from the Fall of 2018 and the Spring of 2019 while using the Reflex Math Fact Fluency Program for the school year. The data from Section 2 showed that the Star Math Assessment scores improved from the pretest in the fall to the posttest in the spring. Only one student showed a loss of 18 points, while the remaining 97 students showed gains. In the Fall of 2018, the girls scored higher than the boys, and in the Spring of 2019, the girls scored lower than the boys. According to the data presented, the Reflex Math Fact Fluency Program did make an impact on the Star Math Assessment scores for second graders. The position paper was the deliverable project based on the findings of the study, and in which, I presented stakeholders with an option to address the problem at the study site elementary school of 59% of students in upper elementary grades not being proficient in math. In the paper, I also provided information and policy development to assist in the process of adopting a new program, such as Reflex Math Fact Fluency.

Rationale

The purpose of this quantitative, causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at the study site elementary school. In this study, I also examined the difference in male and female scores based on a pretest and posttest. A position paper was the most appropriate means to address the implementation of the Reflex Math Fact Fluency Program in schools because it guides understanding of the program and implementation in the school district.

Review of the Literature

In the project review of literature, I located scholarly, peer-reviewed sources that were published less than 5 years ago, in the range of 2014 to 2019. Literature published before 2014 was also used to document theories and traditional methods of math instruction after the use of current literature had reached saturation. Numerous scholarly and professional literature was reviewed, including recent doctoral dissertations, peer-reviewed journals, and subject-specific information from multiple electronic databases.

In this review, I focused on the genre being used for the project: a position paper with policy recommendations. My keyword search terms included: *policy making, policy recommendations, education policy, policy framework,* and *policy implementation*. All online searches were conducted using Google Scholar and databases accessible through the Walden University Library.

I chose the genre of a position paper with policy recommendations to address the problem. The problem at the study site elementary school was that, at the time of the

study, 59% of students in upper elementary grades were not proficient in math. The strength of the project deliverable is that it offers an intervention to use for second- through fifth grade students struggling with math fact fluency. In the paper, I recommended a tool to use for students who are struggling with fact fluency. The project, if adopted, would allow a data-based program to assist with math instruction.

The policy recommendation consists of the following guidelines: (a) define the objective; (b) collect data; (c) construct the alternatives; (d) choose the criteria; (e) predict the results; (f) challenge the trade-offs; (g) halt, concentrate, narrow, expand, choose; and (h) tell your story (Bardach & Patashnik, 2019). The stages are not automatically followed in the order above, and all of them are not required for every problem (Bardach & Patashnik, 2019). The purpose of writing this policy recommendation was to give the school district leaders a recommendation regarding the Reflex Math Fact Program.

Define the Objective of the Policy Recommendation

The problem at the study elementary school was that 59% of students in upper elementary grades were not proficient in math. This figure came from the students in third grade through fifth grade taking the SSA in the Spring of 2018. The SSA uses achievement levels of 1 through 5. To be considered proficient, a student must score a Level 3 through 5. Of the third, fourth, and fifth graders, 59% were not proficient.

The purpose of this quantitative, causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at the study site elementary school. As second graders, the students

are preparing to enter third grade, which is often a chaotic year for students. If the students in third grade do not pass the SSA, they are retained in that grade level. The third grade teachers concentrate heavily on reading to assure their students pass the SSA. Math concepts and skills are also a significant focus. Having second graders ready for third grade with a solid foundation in math fact fluency would take some of the pressure off the students and teachers as they prepare for the high-stakes test.

The primary purpose of the position paper is to provide a summary of a problem, analyze it, and make recommendations (Herman, 2013). The decision-makers at the study site then looked over the policy paper and reviewed it for data and information to make an informed, data-based decision regarding the Reflex Math Fact Fluency Program. According to Bardach and Patashnik (2019), the first section of the position paper, defining the objectives and problem, is a crucial step in the process of writing a position paper.

Assemble Data

Data-based decision-making has become a staple in the American school system. According to Filderman and Toste (2017), data-based decision-making is the process of gathering and interpreting data to adjust practice. Teachers often use data-based decisions in the classroom to individualize and differentiate instruction. Data-based decision-making is more prominent in education than it has ever been due to educational policies, such as No Child Left Behind and Every Child Succeeds Act (Robelen, 2012). Gelderblom, Schildkamp, Pieters, and Ehren (2016) defined data-based decision-making in the field of education as the processing of data (i.e., assessment data, surveys, and

classroom observations) by educators and school boards, which involves collecting, analyzing, and interpreting data to study educational practices.

Construct the Alternatives

According to Bardach and Patashnik (2019), constructing the alternatives is a process whereby the policies or alternative actions or strategies are listed. A list is made of all actions that related to the decision and were discarded in the decision-making process after looking at the data (Bardach & Patashnik, 2019) . Bardach and Patashnik suggested considering three questions when making the decision: How would you solve the problem if cost were no object? Where else could it work? Ask yourself, why not? Using these questions, the data, and research, the next step is to choose one option that works (Bardach & Patashnik, 2019). To make the best decision, stakeholders should look at quantitative and qualitative research, analyze and make sense of the data, and remain objective (Herman, 2013).

Select the Criteria

Policies have two interconnected but separate plotlines: analytic and evaluative (Bardach & Patashnik, 2019). The analytic is related to facts, and evaluative relates to judgments (Bardach & Patashnik, 2019). In this step, values and philosophy come into play (Bardach & Patashnik, 2019). The most important part of this portion of the project is whether the outcome solved the problem (Bardach & Patashnik, 2019). The creation of a policy paper provides a person who makes decisions with an overview of the issue, targeted analysis, and recommendations (Herman, 2013).

Selecting the criteria for the policy analysis is an important step in the process because it introduces values and philosophy (Bardach & Patashnik, 2019). In a policy paper written by Gibbs (2018), the criteria selected were contextual problems (i.e., income), possible alternatives, and factors (if any) that were harmful to the educational system. The policy paper was aimed at determining whether education in an anxious world teaches students to be more human and inclusive. Gibbs began with the premise that education is under threat by the political climate. Honan, Connor, and Snowball (2017) authored a policy paper to examined the need to provide a literacy assessment to first-year students in the area of phonics. They used criteria that included the impact of the assessment of students, the importance of research-based intervention, and any concerns the assessment caused.

Project the Outcomes

Bardach and Patashnik (2019) defined projecting the outcomes as providing the impact of each alternative presented in the policy paper. This section of the policy paper is most difficult and is often left out of the process by seasoned policy analysists but is nonetheless significant (Arnold, 2012). When considering the projecting outcomes section of the policy paper, first, the writer must remember that policy is about the future (Arnold, 2012). Secondly, projecting policy outcomes is about being realistic about the policy (Bardach & Patashnik, 2019). Since being optimistic is often preferred, trying to find realism can be uncomfortable (Arnold, 2012). Finally, when projecting policy outcomes, it is vital to remember that even though individuals would like to be 100% comfortable presenting a policy that affects the future, that can never happen (Bardach &

Patashnik, 2019). Predicting what may work and produce a change in the future is never an exact science (Bardach & Patashnik, 2019).

According to Bardach and Patashnik (2019) when projecting the outcomes, it is best to be realistic. Langie and Pinxten (2018) wrote a policy analysis that focused on the impact of a European program readySTEAMgo on the academic readiness of first-year students in STEM programs. In listing outcomes, Langie and Pinxten promoted data-based decision-making; cooperation among levels of the stakeholders, such as high school and college; study skills; and engaging in best practices for students. In a policy analysis written by DeBettencourt, Hover, Rude, and Taylor (2016), solutions were recommended for doctoral programs in need of exceptional student education faculty. They provided several projected outcomes, including continuous evaluation of doctoral programs, increasing the funding for special education doctoral studies, enacting recruitment strategies, and the monitoring of supply and demand for special education students in the doctoral program.

Confront the Trade-Offs

Bardach and Patashnik (2019) described the sixth step of policy analysis as looking at the one policy recommendation that has the best-expected outcome and choosing that one. The process of choosing one best recommendation is called dominance (Bardach & Patashnik, 2019). The best way to choose the one, best policy is by revisiting the data (Bardach & Patashnik, 2019) . The recommendations that are traded off are often called alternatives (Bardach & Patashnik, 2019) . According to Bardach and Patashnik, money is often a significant factor when considering one recommendation

better than another. Rank ordering recommendations is a way to show stakeholders all the possibilities in policy analysis (Bardach & Patashnik, 2019) .

Malec, Stagg-Petersen, and Elshereif (2017) conducted action research by giving oral assessments to children ages 4 to 8 years-old aimed at creating an oral language assessment tool. The most immediate policy recommended was that of organizing a forum for teachers, literacy coaches, and speech-language pathologists to work together and learn from one another. Alternate choices were also given, such as supporting oral language in the classrooms of kindergarten and first graders. Thomas (2017) created a policy paper directed at decentralizing education in Malawi. The policy recommendations were numbered in order of importance.

Stop, Focus, Narrow, Deepen, Decide!

In this seventh step of the process of creating a program paper, attention was focused toward narrowing and deepening the analysis (Bardach & Patashnik, 2019). At this point in the process the policy creator must look at the investigation and decide what to recommend. Bardach and Patashnik (2019) suggested the Twenty-Dollar-Bill-Test. The trial is based upon an old joke that has two gentlemen walking down the road when they see a 20 dollar bill laying on the ground. One bends down to pick it up, and the other comments that it cannot be a 20 dollar bill, or someone would have already picked it up from the street. Using the Twenty-Dollar-Bill-Test, the writer of the policy asks if the idea is so great, why has someone not picked it up and implemented it already.

Loomis (2018) created a policy recommendation that focused on intervention for children from traumatic backgrounds that enter school. Developing trauma-informed

preschools was the focus of the policy (Loomis, 2018). Using preschools that are trauma-informed is a unique idea and stood up to the Twenty-Dollar-Bill-Test; however, Loomis also considered alternatives and presented all of them in the policy analysis. Miglani, Awadhiya, Singh, Gowthaman, and Kansal (2018) recommended policy for open and distance learning opportunities for those in trade school, so students leave high school prepared for the workforce. To recommend policy, Miglani et al. analyzed the data gathered and based the recommendations solely on the data.

Tell Your Story

The final step, Step 8, focuses on telling the story. According to Bardach and Patashnik (2019), it is at this point that the problem is redefined, the hypothesis is reviewed with the alternatives, criteria are looked at, projections are reassessed, and writing of the policy begins. Before writing, remember the intended audience, consider how the results will be projected, make sure it is logical, and understand that all eight steps in the process may not be used (Bardach & Patashnik, 2019).

To present policy recommendations on gender equality, Lourenço (2016) created thematic signs that users could download. Links to each of the posters were provided within the body of the policy recommendation. White (2018) used a PowerPoint presentation to make recommendations to the pharmacists advancing health care. The PowerPoint was concise and to the point with only four slides. Bardach and Patashnik (2019) recommended some additional ways to present the policy such as using a memo (for a minor policy change), press release, and using charts and graphs to present the data.

Whatever medium is used for policy presentations, it should be easily accessible and done with the audience in mind.

Project Description

Educators can use the Reflex Math Fact Fluency website for support. Reflex Math Fact Fluency's parent company Explore Learning offers a grant for 1 year for teachers who have never had one in the past. The grant covers professional development and access for 35 students for 1 calendar year of school, which is a potential resource. Reports provided by Reflex are other existing support that offers detailed reports to teachers and administration. The study site elementary school provided the technology needed to implement the program. Funding provided by the district is another resource that can be utilized to fund the program for schools. The study site elementary school's leadership team was a resource that was accessed to provide support through teacher observations and data analysis. Coordinating with the technology manager and administration at the study site's elementary school is another resource needed to manage scheduling, Internet connections, and equipment for teachers.

Potential Barriers

Barriers for implementation of the Reflex Math Fact Fluency Program are the cost of the program and the requirement of 30 minutes of use per day per student. The cost of the Reflex Math Fact Fluency Program is $3,295 per school (Explore Learning, 2019). The study site elementary school has approximately 700 students with the cost per student being $4.70. The study site elementary school could use Title I funds to purchase the program or other district mathematics funds. Businesses also sometimes adopt a

school to help with such costs. Another barrier is that the program requires 30 minutes of use per day per student. Teachers sometimes have a difficult time fitting the 30 minutes per day into the schedule. Using a daily math center rotation with Reflex being one of the centers is one way to address the time factor. At the end of each day, many buses come 30 to 40 minutes late picking up students. Implementing Reflex after school while waiting for bus pick up is another solution to the barrier of time.

Proposal for Implementation and Timeline

The Reflex Math Fact Fluency policy recommendation should take place rapidly as it only needed to be approved at the school level. To ensure the policy is acceptable to stakeholders, I presented the new policy and position paper to the leadership team of the study site elementary school in the Fall of 2019. Support for the program influenced whether an acceptance of the policy is granted. The leadership team met every Monday morning, so the policy was presented to the team during the first quarter of school in 2019. The entire process was completed by November 2019.

Roles and Responsibilities for Stakeholders

The school administrator needed to address the budgetary issue with financing the program for the school. The Title I Coordinator for the school provided the Title I budget and reported if there was available funding for the school year. After implementation, teachers entered their students' names into the Reflex Math Fact Program online, read and provided reports, and progress monitored using Star Math Assessment in the fall, winter, and spring. Monitoring student use was a responsibility for teachers and the math

coach. The network manager was responsible for sending out the Math Fact Fluency Program icon to all school computers for students.

Project Evaluation Plan

As noted earlier, the primary purpose of the position paper was to provide a summary of a problem, analyze it, and make recommendations (Herman, 2013). Delivery of the project outcomes was the use of a position paper to create a new policy related to the Reflex Math Fact Fluency program. The research focused on the Reflex Program and its use in an elementary school. The district collected data, and it was used to compare the Fall 2018 and Spring 2019 Star Math Assessment scores. The data analysis was used to inform the committee regarding the Reflex Math Fact Fluency Program, and its value in addressing the problem at one elementary school which was that 59% of students in upper elementary grades were not proficient in math.

Goals of the Project

The purpose of this quantitative causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at one elementary school. The findings revealed that the Reflex Math Fact Fluency Program did make an impact on scores for students who took the test in the Fall of 2018 and the Spring of 2019. The scores showed a difference in the mean between the two tests of 109.36. The Reflex Math Fact Fluency Program appears to have made a difference in test scores for the second graders at one elementary school. Based on the data, I rejected the null hypothesis for the second research question of whether boys would score higher than girls. The mean difference in the Fall 2018 scores was 8.67, and

the difference in the mean Spring 2019 scores was 4.46 between genders. In the Fall of 2018, the girls scored higher than the boys. In the Spring of 2019, the girls scored lower than the boys. According to the data presented, the Reflex Math Fact Fluency Program did make an impact on the Star Math Assessment scores for second graders.

One of the goals of the position paper was to provide the stakeholders with an understanding of the Reflex Math Fact Fluency Program. The problem at one elementary school was that 59% of students in upper elementary grades were not proficient in math. The stakeholders of the study site elementary school understood the Reflex Math Fact Fluency Program, implementation, the time table for using the program, and pulling reports from Reflex. The stakeholders must understand how it is implemented in the daily classroom schedule as well as the time table that needs to be followed for the program to be successful. There are a variety of reports available for teachers and administrators to use to view student progress, growth, user statistics, and certificates to give to students. A process to award certificates would also need to be created to give students the various awards as there are several.

The stakeholders of the study site elementary school became acquainted with the steps for implementing the Reflex Math Fact Fluency Program in their school. Implementation of the program required the administration to understand the correlation between using the program with fidelity, and the outcomes that were usage generated. It was also significant for administrators to come up with schoolwide incentives for students to encourage them and their success with the program. Teachers would need to learn how to set the program up with the variety of computers in the classroom, enter

students into the roster, and access classroom reports. Reflex Math Fact Fluency Program's website offers webinars to assist with the various aspects of training (Explore Learning, 2019). Training administration and staff in the implementation of the program assisted in using the program with fidelity in the classroom.

The school leaders were shown tools to delve deeper into data analysis using the program's results. Data-based decision-making is the way to make informed changes in the classroom. Stakeholders would need to be given an overview of the many reports available for them to assure the program is working for the school. In analyzing the data, the Reflex data would be compared to the Star Math Assessment in the fall, spring, and winter. The goals for the program policy aided in the implementation and training for using Reflex Math Fact Fluency Program in the study site elementary school.

Description of the Key Stakeholders

The key stakeholders involved in the policy recommendation were school faculty and staff at the study site elementary school. The administration, which included the principal and assistant principal were a significant part of the process. Each week the leadership team met to review data and go over policies and procedures for the school. The study site elementary school leadership team consisted of the school's math coach, reading coach, science coach, exceptional student education facilitator, guidance counselor, school psychologist, assistant principal, and principal. Each member of the team performed a substantial role in the implementation of the Reflex Math Fact Fluency Program. Other stakeholders included the second through fifth grade teachers, students in second through fifth grades, and the parents of those students.

Project Implications

The implications for positive social change from this study included providing administrators, teachers and the school district with a causal-comparative study that may provide information to foster a data-driven decision-making process regarding the continuation of the Reflex Math Fact Fluency Program. The program policy provided it was implemented, would provide an intervention to use for math at the study site elementary school that may increase student achievement, which affects the community. When a school achieves success on the school grade given by the SDOE, the community rallies around schools with higher grades. The school's staff is given bonus money, attracts highly qualified teachers, and local business who offer support. Students who come from schools earning a school grade of D or F are permitted to attend the A, B, and C schools with transportation. The community reaches out to schools with higher grades with support. Those schools receiving lower grades are often overlooked by the community with articles in the local newspaper publishing school grades. If the grade is not adequate, it is often difficult to find teachers and community support. The perception of the school to the community and the stakeholders is an asset and using an effective intervention to advance math fact fluency affected the influence of the school.

Conclusion

In Section 3 I presented a description of the policy recommendation that was created as a result of this study. The chapter included a summary of each component of the project. A review of the literature was also conducted with a focus on the project genre, policy recommendation. Section 4 includes reflections and a conclusion, the

project strengths and limitations, recommendation for alternative approaches, scholarship, project development and evaluation, and implications, applications, and directions for future research as well as a conclusion to the study.

Section 4: Reflections and Conclusions

Introduction

In this section, I reflected on and discussed the conclusions that were derived from this study. In chapter 4 I included the strengths and limitations of the project, recommendations for alternative approaches, project development and evaluation, reflection on the importance of the work, implications and applications, and directions for future research. This section allowed me to reflect on the project and its importance going forward.

Project Strengths and Limitations

As a seasoned educator working in the school district, I often ask myself what more can I do to help students succeed. Despite endless conversations regarding math achievement, some students fall through the cracks. The strengths of this project included addressing the problem at the study site elementary school in the area of mathematics achievement concerning 59% of students in upper elementary grades not being proficient in math.

The strength of the project deliverable was that it offered an intervention to use for second- through fifth grade students struggling with math fact fluency. Currently, flashcards and fact fluency games and drills are being used to teach fluency. In the position paper, I recommended another tool to use for students who are struggling with fact fluency. The project, if adopted, will allow a data-based program to assist with math instruction.

The purpose of this quantitative, causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at the study site elementary school. In the position paper with policy recommendations, I took the findings from this study and used them to make a recommendation on how best to implement the Reflex Math Fact Fluency Program in the study site elementary school. The method used to write the plan was reliable, but as in all things, there were limitations. The policy was written to provide a technological tool to help with math fact fluency, the Reflex Math Fact Fluency Program. The school district is a large one with a little more than 100 schools and over 100,000 students. Purchasing the Reflex Math Fact Fluency Program for over 100 schools would be an expensive endeavor even using Title I funds.

Recommendations for Alternative Approaches

This position paper included a policy recommendation. An alternative way to address the problem with student achievement in math resulting from a lack of math fact fluency would be to use the professional development option. The professional development option would allow for specific training for the stakeholders, including parents. If the recommendation is not implemented, the professional development would be impractical. For that reason, I did not select the professional development approach because I felt the recommendation to adopt the Reflex Math Fact Fluency Program should come first before professional development.

A curriculum plan would have been another alternative approach for this project. A curriculum plan is the development of a plan for the curriculum to be used by the

school. The Reflex Math Fact Fluency Program was already developed along with professional development and reports. Because of the prior development of the online program, this alternative approach for the project was not chosen. After careful consideration, I chose the policy recommendation for this study.

Scholarship, Project Development and Evaluation, and Leadership and Change

My doctoral study has been a journey toward scholarship. When I first began the program, I would have addressed a concern differently, probably with little data analysis. After my work in the program, I now approach educational concerns based on the analysis of data. Learning to use data analysis and employing data-based decision-making has often given me surprising results. I have used the process of data analysis and attacked a problem to find out my hypothesis was incorrect by a long shot. Learning to apply data analysis has been one avenue to sound decision-making for me.

Writing skills were another area of scholarly growth for me. Before beginning the program, I was a good writer, but after applying the processes I saw improvement. Using resources that are peer reviewed and current was one significant area that has improved my writing. The writing skills I have acquired will serve me well in all aspects of my career as I research a problem; write recommendation letters, e-mails, and memos to staff; and address district-level officials. Knowing how to write and reinforcing my writing with sound research is a skill I will use regularly.

Writing a policy recommendation was out of my comfort zone. I am a person who loves professional development. I love to create, present, and dialog with the stakeholders; however, the professional development option did not align well with what

I needed to communicate to stakeholders. Writing a policy recommendation taught me about the structure and format of presenting policy. It also taught me what those who are on the receiving end of the policy paper are looking for to make an informed decision. As a scholar, I hope to publish in the future and continue researching other issues as they come about.

Reflection on Importance of the Work

The research that I have conducted offers a solution to the problem the study site elementary school had concerning 59% of students in upper elementary grades were not proficient in math. Many schools across the United States have the same problem. Math fact fluency is a well-researched topic; however, there is little research on the Reflex Math Fact Fluency Program. In this study, I provided some analysis of the fluency program used by so many. There were many reviews of the program available, but there were few, if any, published journal articles on the topic of Reflex Math Fact Fluency.

This study also gives the district study results they can use for data-based decision-making. The school district is a large district that is tasked with overseeing more than 100 schools. Finding the available staff to research the Reflex program helps them in their decision-making process. Using the product at this time is a school-based decision; however, in the future, it could be a product used by all of the district's schools.

Implications, Applications, and Directions for Future Research

I conducted this study to address the problem of upper elementary grade-level student achievement in math at the study site elementary school. Math achievement is one content area that goes into each school's grade in the state. In the state schools

receive a letter grade of A through F, according to points received in ELA, math, science, and learning gains. For elementary schools, there are 700 possible points to be earned toward achieving a school grade, and math accounts for 100 of these points. Schools in the state who do not score well are the object of ridicule by the press and the community, receive strict oversight by the state, are given mandated policies, and their students are permitted to attend other schools who have made the grade. Having a letter grade of a D or F is a community nightmare. Parents, district officials, and the state demand to know why. Principals and assistant principals are moved to assume they did something wrong to cause the poor grade. This study was aimed at improving student achievement in math, which in turn impacts the community of an elementary school that used to be a D school.

In this project, a position paper with a policy recommendation, I suggested a change in math fact intervention for students. If accepted by the study site elementary school, it will be implemented in second- through fifth grade classrooms to help students attain math fact fluency. The deliverable, the policy paper, was delivered to the school's leadership team at a weekly team meeting. If the team accepts it, the program will be placed in classrooms in the next school year.

Future research of this topic should include an experimental study: A comparison of second grade classes at another school that is not using the program as compared to students who are using it at a different school. An experimental study would provide a more in-depth look at the data in both schools to compare. Lodico et al. (2010) explained that in experimental research, to test an idea, one group is given a treatment, and one

group is given no treatment. Using an experimental study could compare the two schools after a year of using the Reflex Math Fact Fluency Program.

Conclusion

A policy recommendation with a position paper was the deliverable created based on the results of my research. I have discussed the strengths and limitations of the project as well as provided suggestions for alternative approaches. I also reflected on myself as a scholar and the importance of the work. Implications, applications, and directions for future study were also addressed. The project deliverable could change the way the school district teaches students math fact fluency and increase student achievement in math at the study site elementary school.

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Appendix: Policy Recommendation, Position Paper

A policy recommendation, position paper, to the leadership team at the study site elementary school concerning the use of the Reflex Math Fact Fluency Program.

Introduction

Math Fact Fluency is a foundational skill that must be addressed in elementary school to avoid problems in math in secondary school. A gap in practice for one elementary school, when compared to all schools in the region, has been identified by the 2018 the State's Standards Assessment (SSA) data in mathematics. After taking the SSS in the Spring of 2018, only 59% of students in third through fifth grades were proficient in math. Second grade students take the SSA for the first time in third grade. Sending students to third grade with a solid foundation in basic math facts sets them up for success on the SSA in math. This study contributed to filling the gap in practice by completing a causal-comparative study of the Reflex Math Fact Fluency Program to verify if the program was effective in helping students in second grade carry math fact fluency with them to third grade, the first tested grade. The Reflex Math Fact Fluency Program claims that it helps students with math fact fluency, continuously differentiates instruction for students, makes math fun and motivating as students play games with math facts to achieve success, and provides reports for teachers and administrators (Cholmsky, 2014).

The Problem

The problem at one elementary school is that 59% of students in upper elementary grades were not proficient in math. Knowledge of basic math facts was a significant

problem for students in upper elementary who were not learning basic math facts with automaticity to assist them in higher-level math skills. According to Nelson, Burns, Kanive, and Ysseldyke (2013), students who struggle with math facts in elementary school may continue to have difficulties in math until the math facts are mastered. Baker and Cuevas (2018) found that automaticity in math is critical for future math performance. Students who do not master the basic math facts struggle in higher-level mathematical skills.

The Current Policy

Currently, there is no prescribed policy for math fact fluency in the school district. According to D. Henderson (personal communication, July 13, 2019), the schools in the district used Freckle math for the 2019-20 school year for math progress monitoring. The Freckles program does have a math fact fluency component, but some schools use Ten Marks or Prodigy for math fact fluency. Math fact fluency tools are left up to the individual school to choose. If the school decides to use a program that requires funding, they decide to purchase it out of the annual budget or Title I funds.

Research

The literature review focused on the components of a policy recommendation. Bardach and Patashnik (2019) suggested eight steps to create a policy recommendation. Many of their stages were implemented; however, I would like to focus on the target audience. The policy recommendation was presented to a school leadership team who decided whether to accept or decline the policy recommendation. Each audience needs different information and has a variety of needs (Sun, Hou, Hou, & Li, 2015). The school

leadership team had a different agenda than the district school board. Knowing the age, gender, and social status are usually characteristics to consider when considering the target audience. In this case, the target audience consisted of all educators who were charged with making decisions for an elementary school. The policy program recommendation presented to the school leadership team was less formal and called for answering more detailed questions about the program and the data.

Synopsis of the Study

I began the study by discussing the local problem at elementary school. The problem at one elementary school is that 59% of students in upper elementary grades are not proficient in math. The problem was defined using data from the study site elementary school's state standard assessment scores in math. Research questions were then formulated, which lead me to conduct a literature review on math fact fluency and online math fact programs. After completing the literature review, I discussed the research design and approach I would use for the study. I also discussed the setting and sample, as well as instrumentation and materials.

The purpose of this quantitative causal-comparative study was to examine the influence of the Reflex Math Fact Fluency Program on second graders' math achievement scores at one elementary school. The findings reveal that the Reflex Math Fact Fluency Program did make an impact on scores for students who took the test in the Fall of 2018 and the Spring of 2019. The scores showed a difference in the mean between the two tests of 109.36. The Reflex Math Fact Fluency Program appears to have made a difference in test scores for the second graders at one elementary school. The mean

difference in the Fall 2018 scores was 8.67, and the difference in the mean Spring 2019 scores was 4.46 between genders. In the Fall of 2018, the girls scored higher than the boys and, in the Spring of 2019, the girls scored lower than the boys. There was a significant interaction ($F(1) = 3472.822$, $p = .000$) affect between the male and female groups according to the data. The data also showed a crossover in scores. According to the data presented, the Reflex Math Fact Fluency Program did make an impact on the Star Math Assessment scores for second graders.

The Policy Recommendation

The policy recommendation was based on the findings of this research, which focused on whether the Reflex Math Fact Fluency Program would make a difference in the Fall 2018 and the Spring 2019 Star Math Assessment scores. The results of the study suggested that the Reflex Math Fact Fluency Program does make a difference in math scores for second graders. The policy recommendation is based on two factors that were presented in the literature (a) math fact fluency is a significant factor in future math achievement, (b) the impact of math fact fluency intervention.

Research findings illustrated the significance of math fact fluency in attaining achievement in mathematics. Fluency in math facts refers to a rapid, automatic, and accurate response to a math fact in one of the four basic operations of addition, subtraction, multiplication, and division (Musti-Rao, Lynch, & Plati, 2015). A commonly cited benefit of math fact fluency is a lower demand on working memory and less math anxiety (Musti-Rao et al., 2015). Math fact fluency also affects higher-level

math skills. According to Nelson, Burns, Kanive, and Ysseldyke (2013) math fact fluency is a cornerstone to future skill development and more complex math.

Math fact fluency was an essential skill that many students were lacking. With the significance of math fact fluency in higher-level math, practices for increasing fluency have been identified in the literature. Berrett and Carter (2018) found that fluency building instruction should include modeling, practice, immediate feedback, and incorporation of known and unknown facts to students. Rave and Golightly (2014) also found that direct feedback increases the rate of math fact retrieval as well as engagement in the activity. The Reflex Math Fact Fluency Program provides modeling, practice, immediate feedback, and engagement. Because of these findings, it is recommended that one elementary school develop a policy for math fact fluency. The study site elementary school should employ the Reflex Math Fact Fluency Program to develop math fact fluency.

Recommended Course of Action

This policy recommendation took the position that math fact fluency should be a priority in math instruction. According to the literature, math fact fluency is crucial to obtaining math success. Students who are not confident with their math facts experience difficulties with higher-level math and suffer from math anxiety. For students to become fluent in math fact fluency, an intervention must take place that uses modeling, feedback, and engagement. Intervention using the Reflex Math Fact Program is recommended.

The policy recommendation does require funding, which is decided at the local level. Funding the program could come from the general or Title I budget. The company

does offer a one-year grant for second grade through fifth grade classroom teachers. Those who have not already received the grant may apply. The cost of the program is $3,250 for a school license, which is approximately $5 per student. The program can be used at home year-round as well as at school since it is an online program.

This policy recommendation provided intervention for the study site elementary school. Many of the surrounding schools have adopted the program to use for math fact fluency. The policy paper was presented to the study site elementary school's leadership team at a weekly meeting. If they choose to adopt the program based on the data, implementation will take place in the 2020-2021 school year with professional development presented for teachers in advance.

Project Evaluation

Evaluation is a necessary component of the policy recommendation. According to Picciotto (2019), evaluation is a way to help reverse trends that cause anxiety or problems. An evaluation provides a way to make a positive contribution or change to the work (Janakiraman, Bullemore, Valenzuela-Fernández, & Jaramillo, 2019). This policy recommendation was evaluated with data from the state's standardized assessment and the Star Math Assessments. The purpose of the policy was to address the implementation of the Reflex Math Fact Fluency Program in an elementary school, help the stakeholders to understand the program, and implement the program. Using the assessments, the district uses to monitor student progress will, in turn monitor progress of the policy recommendation.

Conclusion

Math fact fluency is critical to student achievement in math. To solve the problem of math fact fluency for one elementary school, the Reflex Math Fact Program was utilized for one school year in second grade. The data showed that the Reflex program made a difference in scores for students from the 2018 Fall Star Math Assessment to the 2019 Spring Star Math Assessment. Currently, students use drill and practice in most classrooms to achieve math fact fluency. The Reflex Math Fact Fluency Program was the proposed intervention to use for math fact fluency in place of drills. If implemented, this policy will be initiated according to the readiness of the staff to begin the program operation. Math fact fluency can be attained by all students if given appropriate interventions to guide them to automaticity.

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